

Applicant requests favorable reconsideration and withdrawal of the rejections set forth in the above-noted Office Action.

Claims 11-13 were rejected under 35 U.S.C. § 102 as being anticipated by either U.S. Patent No. 5,142,548, to Krasinski et al., or U.S. Patent No. 5,040,896, to Moslehi. Claims 14 and 15 were rejected under 35 U.S.C. § 103 as being unpatentable over the Krasinski et al. patent in view of U.S. Patent No. 5,117,433, to Tatsuno et al. Claims 16 and 17 were rejected under 35 U.S.C. § 103 as being unpatentable over the Krasinski et al. patent in view of U.S. Patent No. 5,696,628, to Sutton et al. Claims 18-21 and 26 were rejected under 35 U.S.C. § 103 as being unpatentable over U.S. Patent No. 5,880,891, to Furter in view of the Krasinski et al. patent. Claims 22, 23 and 26 were rejected under 35 U.S.C. § 103 based on this art combination and further in view of the Tatsuno et al. patent. Claims 24, 25 and 26 were rejected under 35 U.S.C. § 103 as being unpatentable over a combination of the Furter patent in view of the Krasinski et al. patent, and the Sutton et al. patent. Applicant submits that the cited art does not teach many features of the present invention, as recited in the independent claims. Therefore, these rejections are respectfully traversed.

In one aspect of the invention, independent claim 11 recites an optical system for use in a projection exposure apparatus. The optical system includes a plurality of lenses having birefringence and at least one optical element for correcting the birefringence of the plurality of lenses.

In another aspect of the invention, independent claim 18 recites a projection exposure apparatus that includes an illumination system for illuminating a reticle with light and a

projection optical system for projecting a pattern of the reticle onto a wafer. The projection optical system includes a plurality of lenses having birefringence and at least one optical element for correcting the birefringence of the plurality of lenses.

Applicant submits that the cited art does not teach or suggest such features of the present invention, as recited in independent claims 11 and 18.

The Krasinski et al. patent relates to a projection optical system that includes a birefringence element 7 of an optical system that may function to narrow the bandwidth of the light from the laser medium. Applicant submits, however, that the optical system in the Krasinski et al. patent includes no lens element having birefringence. Therefore, the device in that patent does not function to correct birefringence of the lens, in the manner of the present invention recited in independent claims 11 and 18.

The Moslehi patent shows an optical system having birefringence elements 34, 35 and 36. Those elements, however, likewise do not function to correct birefringence of a lens in the manner of the present invention recited in independent claims 11 and 18.

Similarly, the Furter patent does not teach or suggest the salient features of Applicant's present invention, as recited in independent claims 11 and 18. That patent shows a projection exposure apparatus having a projection optical system which includes quarter wave plates 19 and 20. This patent merely discusses that the projection optical system is arranged to control the polarization of imaging light rays on the basis of the birefringence of the quarter wave plates. That patent is completely silent, however, regarding aberration that may be caused by such quarter wave plates.

Applicant submits that a combination of the Furter patent and either the Krasinski et al. patent or the Moslehi patent also would not teach Applicant's present invention, as recited in independent claims 11 and 18. The projection exposure apparatus in the Furter patent uses an ordinary excimer laser as a light source. That patent does not use a solid laser such as shown in the Krasinski et al. patent or a wavelength stabilization optical system such as shown in the Moslehi patent. Therefore, Applicant submits that it would not have been obvious to incorporate the structure of either the Krasinski et al. patent or the Moslehi patent into that of the Furter patent.

More specifically, even if the birefringence element of the Krasinski et al. patent or the Moslehi patent were to be incorporated into the projection optical system shown in the Furter patent, Applicant's present invention recited in independent claims 11 and 18 would not result. This is true, since the birefringence elements disclosed in the former patents do not function to correct the birefringence of a lens or the aberration caused by the birefringence.

Applicant further submits that the remaining art does not cure the deficiencies noted above.

The Examiner relies on the Tatsuno et al. patent for the use of a diffraction grating on the surface of an optical element to produce birefringence and the Sutton et al. patent for teaching that producing a predetermined stress distribution in an optical element is effective in producing birefringence. These patents, however, as with the remaining art cited, do not teach or suggest correcting birefringence of a plurality of lenses in the manner of the present invention recited in independent claims 11 and 18. Therefore, these patents add nothing to the teachings of those

discussed above that would render obvious Applicant's present invention recited in independent claims 11 and 18.

For the foregoing reasons, Applicant submits that the present invention, as recited in independent claims 11 and 18, is patentably defined over the cited art, whether that art is taken individually or in combination.


The dependent claims also should be deemed allowable, in their own right, for defining other patentable features of the present invention in addition to those recited in their respective independent claims. Individual consideration of these dependent claims is requested.

For reasons similar to those advanced above with respect to independent claims 11 and 18, Applicant submits that claims 27-29 patentably define features of the subject invention. Specifically, the cited art is not read to teach or suggest at least the feature of a plurality of optical elements including lenses each having birefringence, in which the plurality of optical elements are arranged so that the birefringence can be corrected as a whole. Therefore, claims 27-29 likewise should be deemed allowable.

Applicant further submits that the instant application is in condition for allowance. Favorable reconsideration, withdrawal of the rejections set forth in the above-noted Office Action and an early Notice of Allowance are requested.

Applicant's undersigned attorney may be reached in our Washington, D.C. office by telephone at (202) 530-1010. All correspondence should be directed to our address listed below.

Respectfully submitted,



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APPENDIX A

IN THE CLAIMS

11. (Twice Amended) [A projection optical system for projecting a pattern of a first object onto a second object] An optical system for use in a projection exposure apparatus, said [projection] optical system comprising:

a plurality of lenses having birefringence; and

at least one [correcting] optical element for correcting the birefringence of said [projection optical system] plurality of lenses.

12. (Twice Amended) [A projection optical] An optical system according to claim 11, wherein said [correcting] optical element comprises at least one optical member having predetermined form birefringence.

13. (Twice Amended) [A projection] An optical system according to claim 12, wherein said at least one optical member is arranged so that a distribution, including a distribution of

form birefringence produced by said at least one optical member, is effective to cancel the birefringence [to be produced by] of said plurality of lenses.

14. (Amended) [A projection] An optical system according to claim 12, wherein said at least one optical member is arranged to produce form birefringence on the basis of a grating having a period smaller than a wavelength used.

15. (Twice Amended) [A projection] An optical system according to claim 14, wherein said grating is provided on the surface of at least one of said lenses.

16. (Twice Amended) [A projection] An optical system according to claim 11, wherein said [correcting] optical element comprises at least one optical member having a predetermined stress distribution.

17. (Twice Amended) [A projection] An optical system according to claim 16, wherein said at least one optical member is arranged so that a distribution, including a distribution of stresses produced by said at least one optical member, is effective to cancel the birefringence [to be produced by] of said plurality of lenses.

18. (Twice Amended) A projection exposure apparatus comprising:
an illumination system for illuminating a [first object] reticle with light; and

a projection optical system for projecting a pattern of the [first object illuminated with the light from said illumination system, onto a second object] reticle onto a wafer, said projection optical system [having] including a plurality of lenses having birefringence, and at least one [correcting] optical element for correcting the birefringence of said [projection optical system] plurality of lenses.

19. (Amended) A projection exposure apparatus according to claim 18, wherein said illumination system illuminates the [first object] reticle with slit-like light, and further comprising a scanning device for simultaneously scanning the [first and second objects] reticle and the wafer in a widthwise direction of the slit-like light, at a speed ratio corresponding to a projection magnification of said projection optical system.

20. (Twice Amended) A projection exposure apparatus according to claim 18, wherein said at least one [correcting] optical element comprises at least one optical member having predetermined form birefringence.

21. (Twice Amended) A projection exposure apparatus according to claim 20, wherein said at least one optical member is arranged so that a distribution, including a distribution of form birefringence produced by said at least one optical member, is effective to cancel the birefringence [to be produced by] of said plurality of lenses.

25. (Twice Amended) A projection exposure apparatus according to claim 24, wherein said at least one optical member is arranged so that a distribution, including a distribution of stresses produced by said at least one optical member, is effective to cancel the birefringence [to be produced by] of said plurality of lenses.

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